Synthesis of anatase nanoparticles with high specific surface area by miniemulsion technique

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TiO_2 particles with a high specific surface area have many potential applications including white pigments and sensors. The applications depend strongly on the particles size and their crystalline structure. Anatase nanoparticles are of great interest as catalyst support and electrodes in lithium batteries.

In this work we report a simple synthetic approach to anatase nanoparticles by the combination of a novel precursor and an indirect miniemulsion technique. The particles are prepared via a sol-gel route using bis(2-hydroxyethyl)titanate (EGMT) as the precursor. These glycol-modified precursors show the benefit of being water soluble and the release of a highly polar diol (ethylene glycol) upon hydrolysis. Thus they can be easily dissolved in the disperse aqueous phase of an inverse miniemulsion which is stabilized by a non-ionic block copolymer (poly(ethylene-*co*-butylene)-*b*-poly(ethylene oxide)) in an organic liquid. The technique of miniemulsion is of advantage because every droplet acts as a minireactor where the hydrolysis and condensation reactions to the final particles take place. That means that the homogeneous droplets do not influence each other and do not change their size during particle formation.

With this method porous anatase particles with a diameter of about 100 nm and narrow size distribution could be synthesized. After calcination at 400 °C the surface area was determined by nitrogen sorption (BET) and was found to be very high with 250 m^2/g in this study. The materials were characterised by electron microscopy and X-ray diffraction, the latter one indicates a phase transition to rutile at temperatures above 400 °C.